

NRD Assessment of Coastal Areas Pre-Assessment Screen: 43 CFR Part 11.

CALF PASTURE POINT: SITE 07

I. INTRODUCTION, AUTHORITIES, AND DELEGATION

This determination concerns claims for damages to natural resources of the Calf Pasture Point land area, as authorized by the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, (CERCLA), 42 U.S.C. s. 9601, et seq., the Oil Pollution Act of 1990, 33 U.S.C. s. 2701, et seq., the National Park System Natural Resources Damages Act in 16 U.S.C. s. 19jj, et seq., the Clean Water Act, 33 U.S.C. s. 1251, et seq., and Title 42, Chapter 17.1-1, et seq., of the Rhode Island General Laws. This determination recognizes that there is a claim for damages to natural resources within the trusteeship of the United States Department of the Interior, (DOI), the National Oceanic and Atmospheric Administration of the United States Department of Commerce, (NOAA), and the Department of Environmental Management, (RIDEM) and Town of North Kingstown, of the State of Rhode Island.

This determination was prepared by the RIDEM, of the State of Rhode Island, as a trustee of natural resources under the authority of R.I.G.L. s. 42-17.1-2(a), the DOI, and NOAA as trustees for natural resources under the authority of Section 107(f) of CERCLA, as amended, 42 U.S.C. s. 9607(f), the National Contingency Plan, 40 C.F.R. part 300, and the DOI Natural Resource Damage Assessment Regulations, 43 C.F.R part 11.

II. INFORMATION ON THE SITE: (INJURY DETERMINATION)

A. Information on the site and on the discharge, release or contamination:

The Calf Pasture Point Site 07 location is a 189acre isthmus which was part of the U.S. Naval Construction Battalion Center, (NCBC), Davisville, located in North Kingstown, Rhode Island.

The area of Site 07, the lower end of Calf Pasture Point, is located in “Zone 3” of the Main Center of the NCBC Davisville site. The Point is bounded to the southwest and south by Allen Harbor and its entrance channel, respectively; to the east by Narragansett Bay; and to the west and north by Sanford Road. Access to the Point is controlled along Sanford Road by a fence with a locked gate.

The site contained three former munitions bunkers located along “Magazine Road”. The bunkers are earthen, and are located in the middle of Calf Pasture Point just north, south, and east, respectively, of a prominent bedrock outcrop

which rises approximately 55 feet above mean sea level, (MSL). The Navy demolished one of the bunkers, and closed and sealed the other two, in 1997.

Site 07 comprises the area of the Point south of the former munitions bunkers, and the bedrock outcrop, and east of the dirt access road that extends to the Allen Harbor entrance channel shoreline. It is currently overgrown with shrubs, small trees, grasses, and weeds. The history of the area, and of the discharge and contamination, is closely intertwined with the history of the NCBC Davisville naval base.

The history of NCBC Davisville is related to the history of Quonset Point, which was the location of the first annual encampment of the Rhode Island Militia in 1893. During World War I, it was a campground for the mobilization and training of troops, and later home to the Rhode Island National Guard.

In 1939, Quonset Point was acquired by the Navy to establish a Naval Air Station (NAS), with construction beginning in 1940. By 1942, the operations at “NAS Quonset Point” had expanded into what is now known as NCBC Davisville. Land at Davisville adjacent to the NAS, was designated as the “Advanced Base Depot”.

While NAS Quonset Point remained a site of Naval activity, Davisville was inactive between World War II, and the Korean conflict. In 1951 it became the headquarters for the Construction Battalion Center, which loaded ships and trained “CBs” for both the Korean and Vietnam conflicts. In 1974, operations at Davisville were greatly reduced. In 1991 the closure of the NCBC Davisville was announced, and it was decommissioned in 1994. The base was officially closed on April 1, 1994.

1. The time, quantity, duration and frequency of the releases and discharges:

The Point, in the area of Site 07, was reportedly the location of three distinct disposal incidents. These incidents were alleged to involve the disposal of calcium hypochlorite [$\text{Ca}(\text{OCI})_2$], or “bleach”, and a solution known as “Decontaminating Agent Non-Corrosive”(DANC), which is a reactive chlorinated compound. The following is a summary of the historical disposal events as described in the Initial Assessment Study, 1984, and the Record of Decision (ROD), on the remediation efforts, in 1999:

- a. Between 1960 and 1974, approximately twenty (20) five (5) gallon cans (100 gallons total) of calcium hypochlorite were emptied in a drainage ditch along the side of a munitions bunker (Bunker 60), on the Point. Between 1978 and 1982, metal cans containing calcium hypochlorite were removed for offsite disposal. Calcium hypochlorite is a water-soluble solid that degrades rapidly when in contact with water. The commercial product usually contains 50% or more of the chemical. It could not be determined

if all of the calcium hypochlorite disposed of in the area had been removed. The ultimate destination of the alleged offsite disposal was not identified.

- b. In 1973, thirty (30) to forty (40) thirty-five (35) gallon cardboard containers of an unidentified “chloride compound” were stored on the Point. The material reportedly originated at the “utilities school” training area, where it was used for water treatment. Although the compound was not identified, it may have been “ferric chloride” a corrosive solid that is readily reactive and soluble in water. The containers deteriorated over time, and were reportedly buried on site. It is expected that most of the chloride compound leached from the disintegrating cardboard containers during the period of burial on the site.
- c. At some time between 1968 and 1974, a trench measuring 10 feet by 20 feet by 15 feet in depth was filled with three (3) gallon cans containing the “DANC” solution. Given the dimensions of the trench, it is estimated that approximately two thousand five hundred (2500) cans were disposed of, in this trench. The location was covered, and remains undisturbed at the present time. The approximate location of the trench has been estimated based upon various phases of the investigation at Site 07. The DANC solution consisted of two separate chemicals that were mixed to produce a “decontaminating” solution. These consisted of 1,3-dichloro-5, 5-dimethyl-hydantoin, in crystal form, and acetylene tetrachloride, also known as 1,1,2,2, -perchloroethane. The crystal “hydantoin” products are oxidizing agents and readily break down to release chlorine when in contact with water. The DANC solution was apparently used during the Defense Disaster Preparedness Training exercises, involving simulated biological and nuclear warfare attack.

2. Additional contaminants or hazardous substances potentially discharged or released from the site:

Several three (3) gallon rusty cans containing a solid white substance comprised mostly of calcium, were unearthed during the “Confirmation Study” at Calf Pasture Point, Site 07. No further waste materials from past disposals have been found. The releases of constituents of concern (COCs), to the sub-strata at the site are chlorinated volatile organic compounds (VOCs), predominantly as “perchloroethane” and “trichloroethene”, as found in the ground water, resulting from the breakdown of the disposed materials.

3. Responsible Parties

The United States Navy is the responsible party and has initiated remedial action in response to the environmental impacts which have resulted as a consequence of the storage, use and disposal of the chemical compound materials at Site 07. In

November 1989, the entire NCBC Davisville site had been placed on the EPA's National Priorities List (NPL).

In March 1992, the Navy, EPA, and RIDEM entered into a Federal Facility Agreement (FFA) for the remediation for the Installation Restoration (IR) Program sites pursuant to CERCLA. In 1998, the Navy issued a "Proposed Plan" for the cleanup of Site 07 pursuant to the Department of Defense (IR) Program, which parallels the "Superfund" program conducted by the EPA. As part of the IR Program, the Navy had completed an Initial Assessment Study in 1984, and a series of Confirmation Studies in 1991, 1994, and 1998, respectively.

B. Damages excluded from liability under CERCLA and the Rhode Island Hazardous Waste Management Act:

1. Title 43 C.F.R. 11.24(b) notes damages excluded from liability under CERCLA, and requires the authorized official to determine whether:
 - a. the damages resulting from the discharge or release were identified in an environmental impact statement or environmental assessment as an irreversible commitment of natural resources, but the release or discharge was permitted, and the facility was otherwise operating within the law; or
 - b. the damages and the release of a hazardous substance which caused the damage occurred wholly before the enactment of CERCLA; or
 - c. the damages resulted from the application of a registered pesticide under the Federal Insecticide, Fungicide and Rodenticide Act, 7 U.S.C. 135-135k; or
 - d. the damages resulted from any other federally permitted release as defined in Section 101(10) of CERCLA.
2. The hazardous waste management regulations derived from R.I.G.L. s.23-19.1-6, s. 23-19.1-7, and s. 23-19.9-10, address the generation, transportation, treatment, storage and disposal of hazardous materials, and the operation of "hazmat" facilities. There is no comparable provision excluding damages, (more particularly, the occurrence of continuing contamination), resulting from the discharge or release of materials, that pre-dates the 1978 effective date of the statute. Moreover, there has been no presentation of any claim on behalf of a Trustee, regarding any of the affected resources, land area, or circumstances surrounding this injury, to date.

III. PRELIMINARY IDENTIFICATION OF RESOURCES ACTUALLY AT RISK: (DAMAGE DETERMINATION)

A. Potentially Affected resources:

There are chlorinated Volatile Organic Compounds (VOCs) as the primary Constituents of Concern (COCs) in the groundwater at Site 07. There are chlorinated VOCs in shallow strata, deep strata, and bedrock ground water. Overall, one main plume of chlorinated VOCs is present, related to the DANC release that occurred on the Point. The detected VOCs are almost entirely 1,1,2,2-PCA and trichloroethene (TCE), in the vicinity of the release. A third key VOC, 1,2-dichloroethene was detected down gradient from the site of the release.

B. Exposed areas:

The DANC release migrated vertically downward through locally present sand of the silt unit to the underlying tile and bedrock units rather than laterally through the upper sand unit of the site. The chlorinated VOC plume in the ground water appears to be present at greater depths below the ground surface and appears to be mostly in bedrock in designated vicinities on the site. The entire 189acre parcel is affected.

C. Preliminary Identification of pathways:

1. Geology

Site 07 is underlain by five (5) main strata-graphic units, from ground surface to bedrock: a. the *upper sand unit* is a sand with varying amounts of silt and gravel and occasional shell fragments; b. the *silt unit* is the next level, but not present in the vicinity of exposed bedrock at the north of the site; c. the *lower sand unit* is located beneath the eastern portion of the site and consists of very fine to medium sand with varying amounts of silt; d. the *till unit* is comprised of intermixed silt gravel and sand; and, e. *bedrock* which is comprised of fractured quartzite, with zones of phyllite and gneiss.

2. Hydrology

RIDEM has classified ground water at the Point as “GA” and ground under the Site 07 source area as “GA-NA”. Class GA ground water is presumed to be suitable for public or private drinking water use without treatment. Class GA-NA, or non-attainment areas, are those that have pollutant concentrations greater than the ground water quality standards for applicable classification.

The four (4) Site 07 subsurface soil strata, plus bedrock, have been divided into the following three (3) hydrologic zones:

- a. the *shallow ground water zone*, is the saturated portion of the upper sand unit and flows approximately “radially” from the bedrock hill toward the shoreline and into either the harbor, entrance channel or bay;
- b. the *deep ground water zone* is located in the lower portion of the silt unit, the lower sand unit, and the till unit beneath the site; and,
- c. the *bedrock ground water zone*, is located in the investigated upper 25 to 30 feet of competent bedrock, but is suspected to extend deeper.

D. Estimates of concentrations:

Several stages of monitoring wells have been strategically bored into the Point at shallow, deep, and bedrock levels to determine the presence and concentration of COCs in the ground water of Site 07.

There are a total of eighteen (18) shallow bored wells on site.

a. The total VOCs in Shallow Ground Water are:

- 1800 micrograms per liter of Acetone, (Risk Based (RB) concentration for human exposure is 370);
- 1400 micrograms per liter of 1,2-dichloroethene, (RB concentration is 0.12);
- 12000 micrograms per liter of 1,1,2,2 tetrachloroethane, (RB concentration is 0.052);
- 390 micrograms per liter of Tetrachloroethene, (RB concentration is 1.1);
- 130 micrograms per liter of 1,1,2 trichloroethane, (RB concentration is 0.19);
- 3400 micrograms per liter of Trichloroethene, (RB concentration is 1.6);
- 23 micrograms per liter of Vinyl chloride, (RB concentration is 0.019).

There are a total of twenty-four (24) deep bored wells on site.

b. The total VOCs for Deep Ground Water are:

- 190 micrograms per liter of Acetone, (RB concentration is 370);
- 550 micrograms per liter of Benzene, (RB concentration is 0.036);
- 78 micrograms per liter of Bromodichloromethane, (RB concentration is 0.17);
- 34 micrograms per liter of 2-butanone, (RB concentration is 190);
- 4 micrograms per liter of Carbon Disulfide, (RB concentration is 100);
- 100 micrograms per liter of Chlorobenzene, (RB concentration is 3.9);
- 24 micrograms per liter of Chloroform, (RB concentration is 0.15);
- 98 micrograms per liter of Chloromethane, (RB concentration is 1.4);
- 74 micrograms per liter of 1,1-dichloroethane, (RB concentration is 81);
- 120 micrograms per liter of 1,2-dichloroethene, (RB concentration is 0.12);

- 16 micrograms per liter of 1,1-dichloroethene, (RB concentration is 0.044);
- 5700 micrograms per liter of 1,2-dichloroethene, (RB concentration is 5.5);
- 98 micrograms per liter of 1,2-dichloropropane, (RB concentration is 0.16);
- 66 micrograms per liter of dichloropropene, (RB concentration is 0.077);
- 77000 micrograms per liter of 1,1,2,2-tetrachlorethane, (RB concentration is 0.052);
- 1000 micrograms per liter of Tetrachloroethene, (RB concentration is 1.1);
- 96 micrograms per liter of Toluene, (RB concentration is 75);
- 1200 micrograms per liter of 1,1,2-trichloroethane, (RB concentration is 0.19);
- 120,000 micrograms per liter of Trichloroethene, (RB concentration is 1.6);
- 31 micrograms per liter of Vinyl chloride, (RB concentration is 0.019);
- 220 micrograms per liter of Xylenes, (RB concentration is 1200).

There are a total of five (5) deep bedrock wells bored on site.

c. The total VOCs for Bedrock Ground Water are:

- 2 micrograms per liter of Carbon Disulfide, (RB concentration is 2.1);
- 48 micrograms per liter of Chloroform, (RB concentration is 0.15);
- 1 microgram per liter of 1,2-dichlorethane, (RB concentration is 0.12);
- 21 micrograms per liter of 1,1-dichlorethane, (RB concentration is 0.044);
- 2200 micrograms per liter of 1,2-dichloroethene, (RB concentration is 5.5);
- 12000 micrograms per liter of 1,1,2,2-tetrachloroethane, (RB concentration is 0.052);
- 51 micrograms per liter of Tetrachloroethene, (RB concentration is 1.1);
- 390 micrograms per liter of 1,1,2-trichloroethane, (RB concentration is 0.19);
- 27000 micrograms per liter of Trichloroethene, (RB concentration is 1.6);
- 17 micrograms per liter of Vinyl chloride, (RB concentration is 0.019).

IV. PREASSESSMENT SCREEN CRITERIA

The outline of Title 43 CFR Part 11:23(e) criteria that are met as a pre-condition of NRD assessment and claim. The criteria are as follows:

1. A discharge of oil or a release of a hazardous substance has occurred;
2. Natural resources for which a State or Federal agency or Indian tribe may assert trusteeship under CERCLA have been, or are likely to have been, adversely affected by the discharge or release;
3. The quantity and concentrations of the discharged oil or release of hazardous substance is sufficient to potentially cause injury, as that term is used in this part, to those resources;
4. Data sufficient to pursue an assessment are readily available or likely to be obtained at reasonable cost;

5. Responsible actions, if any, carried out or planned, do not or will not sufficiently remedy the injury to natural resources without further action;

These criteria are satisfied for the releases of hazardous substances covered by this pre-assessment screen as follows:

Criteria #1: Discharges of contaminants and releases of hazardous have occurred;

There have been several discharged constituents of concern (COCs) found in the groundwater, at the shallow, deep, and bedrock levels. These are made up of volatile organic compounds, (VOCs), and are presently monitored through a series of wells strategically bored on site, at the distinct levels of groundwater concentration. The concentrations of VOCs in the groundwater beneath Calf Pasture Point consist of dichloro- and trichloroethanes, tetrachloroethene, acetone, benzene, chloromethane, xylenes, chloropropane, carbon disulfide, chloroform, and vinyl chloride. The majority of these exist in proportions greater than the Risk Base for human exposure. The concentrations of contaminants are listed as hazardous substances in Federal Regulations at 40 CFR 302.4, pursuant to Section 102(a) of CERCLA and Section 311 of the FWPCA.

The surface and sub-surface soils in and around the Calf Pasture Point have been found to be contaminated, to varying degrees, yet have not been found to be hazardous to human contact or exposure. The only restriction on residential or recreational use, concerns the volatilization of the COCs, requiring approved ventilation of constructed buildings or facilities on site.

Criteria #2: Natural resources for which the DOI, NOAA, (RIDEM) may assert trusteeship under CERCLA (HAZARDOUS WASTE MANAGEMENT ACT; R.I.G.L. 23-19.1-22(c)) have been or are likely to have been adversely affected by the release or contamination;

The State of Rhode Island, through the Department of Environmental Management, has jurisdiction and trusteeship over the natural resources of the state including waters, soils, and air. **R.I.G.L. 42-17.1-2(a)**. This provision also grants jurisdiction and trusteeship over adjacent areas in the harbor, and affected species such as fish shellfish and other aquatic life. The Town of North Kingstown, a corporate municipal subdivision of the State, is the current owner of the 189 acres of the Site, having received it in deed of transfer from the Navy, in 2001.

Criteria #3: The quantity and concentration of the released hazardous substance is sufficient to actually (potentially) cause injury to those natural resources;

A natural resource injury is a measurable adverse change in the chemical, or physical quality or the viability of that resource resulting either directly or indirectly from exposure to a discharge of a hazardous substance, or a release of oil, or exposure to a chemical reaction resulting from such a discharge or release. At risk on the Site is human exposure to contaminants in the groundwater.

Chlorinated VOCs are the primary constituents in the groundwater of Site 07, Calf Pasture Point. They occur in shallow, deep and bedrock levels. One main plume of the VOCs is related to the DANC release in the vicinity of the two bunkers. The detected constituents are almost entirely 1,1,2,2-PCA and trichloroethene (TCE), in this area. A third VOC, 1,2-dichloroethene (1,2,DCE), was detected down-gradient of the source area. This chemical is known as a degraded product of TCE, and its presence may indicate natural bio-degradation of TCE occurring at the site.

The DANC release migrated vertically downward through sandy facies of the silt unit to the underlying till and bedrock units at the site. The chlorinated VOC plume in the groundwater appears to be at greater depths below ground surface with greater distance from the source area, in bedrock in the vicinity.

The shallow VOC plume detected in the vicinity of the bunkers may be explained by an upward ground-water flow from the lower part of the till unit along the interface within the same saline wedge in that area. The VOC constituents of the plume in the bedrock ground water that extends south beneath the site from the release were not detected in the area across the channel in the monitoring well of Spink Neck. Chlorinated VOCs were also not detected in the sample borings in mid-Allen Harbor. Because chlorinated VOCs were not detected in these areas, to the south and southwest, the chlorinated VOC plume may extend in bedrock towards the southeast, beneath the edge of Spink Neck toward Narragansett Bay.

Most of the detected chlorinated VOC plume, except in the immediate source area, is within “brackish” ground water, or in the fresh and salt-water transition zone. This is anticipated to discharge to the south or southwest within a zone that is a few hundred feet from the shoreline. The offshore sediment was sampled in these areas for the Marine ecological risk assessment (ERA). There was no evidence that showed a link between constituents detected on site, and those detected offshore. The VOC plume is determined not to contribute to the risk in the harbor sediments. The long term monitoring component or the remedial action will ensure that Site 07 discharge poses no unacceptable risk to human health and the environment.

The VOCs in the groundwater are at present a low level threat because there are currently no human “receptors”.

A few inorganic analytes, mostly metals, including the heavy metal nickel, were detected above the NCBC Davisville background concentrations with a few above

drinking water maximum Contaminant Levels, (MCL). These were likely due to the sampling techniques used, the location of the background wells, and the nature of the Site 07 soils with respect to the adjacent marine, or saline environment. The shallow soil is largely comprised of dredged marine sediments. The marine or saline influence on the ground water is evidenced by high sodium concentrations and concentrations of other marine salts such as potassium, calcium and magnesium.

Of the elevated concentrations of inorganic analytes identified in Site 07, ground water, excess cancer risks were associated with arsenic, nickel and beryllium. Excess non-cancer risks were associated with arsenic, manganese, chromium, aluminum, and thallium. During the third phase of testing, only three metals were detected above the MCL in the ground water samples; iron, manganese and thallium. Since these were at or below the background NCBC levels, and below the detected levels in the Bay, they may be related to natural conditions on the Point.

Criteria #4: Data sufficient to pursue an assessment are readily available or likely to be obtained at reasonable cost;

A human health risk assessment (HHRA) was conducted on the basis of the test results from each of the three phases of groundwater exposed, (i.e. Shallow, Deep and Bedrock). A facility-wide ecological risk assessment (ERA) was conducted and included terrestrial and marine assessments.

The HHRA estimated the probability and magnitude of potential adverse human health effects associated with exposure to the constituents detected in the surface soil, subsurface soil, ground water, surface water, inter-tidal sediment, shellfish and soil gas. The HHRA followed the four step process in accordance with the EPA guidelines: (1) identification of the hazardous substances; (2) exposure assessment, including the pathways, populations, nature, and magnitude; (3) toxicity assessment, including the type and magnitude of adverse health effects; and, (4) risk characterization, including potential and actual site specific carcinogenic and non-carcinogenic risks.

Potential human health risks associated with exposure to the constituents were estimated through the development of potential exposure pathways. These pathways were based upon present use, potential future uses, and the location of the contaminated site. The Base Reuse Plan (BRP) for the Point specifies open space/conservation that may include recreational activity. Accordingly, the following exposure scenarios were evaluated: (1) danger to future construction/remediation workers; (2) future onsite recreational users; (3) consumers of locally caught non-purated shellfish; and (4) future residents. The recreational scenario anticipated that a showering facility would be constructed using ground water from the site, as municipal water. A conservative approach

was taken where risks from the exposure pathways and COCs were summed to yield the total carcinogenic and non-carcinogenic site risk for a given receptor.

The calculated cancer risks that exceeded the EPA's upper bound acceptable risks were associated with: a) ingestion of deep and bedrock ground water by future residents due to elevated concentrations of VOCs and organics; b) inhalation of VOCs from the deep and bedrock ground water by showering recreational populations; and, c) dermal contact with VOCs in deep and bedrock ground water by showering recreational populations.

The remainder of the scenarios of exposure were within the EPA's "acceptable" calculated cancer risks range.

A similar analysis was performed for scenarios of "non-cancer" risks and those that exceeded EPA's acceptable levels were associated with ingestion, inhalation, and dermal contact of deep and bedrock waters containing VOCs, as well.

The unacceptable risks at the Point are therefore associated with (1) the consumption of deep and/or bedrock ground water, and activities surrounding (2) the showering with deep and/or bedrock ground water. These are specific to the VOC plume area and not the entire site.

Criteria #5: Response actions, if any, that have been planned or carried out will not or do not sufficiently remedy the injury to natural resources without further action;

Remedial alternatives were developed and subjected to a detailed analysis in the Feasibility Study Report of 1998, also referenced in the ROD. The remedial alternatives consisted of "No Action", as required by the NCP in order to provide a baseline comparison, long term risk monitoring and institutional controls, known as "Deed Restrictions", and three alternatives that provide for the treatment of ground water in addition the "Deed Restrictions":

1. The **No Action** alternative is required pursuant to Section 300.430(e)(3)(ii)(6) of the revised NCP, as a baseline for comparison with other remedial alternatives. Under this alternative, no remedial action or institutional control would be implemented or maintained at the site. Pursuant to CERCLA Section 121 (c), 5-year reviews would be conducted because the COCs would remain on site at concentrations above health-based levels. There is no projected or estimated cost associated with this alternative.

The expected outcome of this alternative is; *unacceptable risk to human health remaining at the site.*

2. The **Deed Restriction and Long Term Monitoring** alternative consists of financial and developmental restrictions on ground water and land use on the

Point. Coupled with this is a long-term risk monitoring program, and 5-year reviews. The only unacceptable risk to human health at Site 07 is the consumption, inhalation, and use of the deep and bedrock ground water. No unacceptable environmental risks were identified or linked to any other use at Site 07. Therefore, a deed restriction on habitable development will effectively address the identified risks at the site.

In order to address the concerns of volatilization of COCs from the site, the deed restriction shall also contain provisions for any construction, building development, structure, facility or other improvement, requiring adequate ventilation approved by the Navy, the EPA, and the RIDEM. The Grantee under the deed shall be required to submit a yearly certification of compliance with the restrictions, to the aforementioned regulators. The ground water and land use restrictions will be incorporated into an Environmental Land Use Restriction (ELUR), which will also be filed and recorded in the land records of the Town, in accordance with state and local law.

The general scope of the long-term risk monitoring program will include sampling of selected shallow, deep, and bedrock wells, and shoreline “piezometers”. The objectives of the long-term monitoring include; (1) verification of the extent of the VOC plume from the DANC release; (2) confirmation that the ground water poses no unacceptable risk to human health or the environment unless used for drinking or showering; (3) confirmation that the ground water discharges to the surface continue to pose no unacceptable risk to human health or the environment at near shore surface water sediment or inland wetland areas; and, (4) confidence that the ground water use restriction remains in effect.

The estimated capital outlay for this alternative is \$130,000, with annual operation and maintenance costs of \$247,000. The total project costs for this alternative are estimated to be \$1,679,000.

The expected outcome from the implementation of this alternative is *that ground water would not be available for beneficial use so long as land use restrictions are kept in place.*

3. **The Anaerobic Biodegradation, and Deed Restriction/Long-Term Monitoring** alternative includes the restrictions and limitations of the previous alternative, coupled with remedial components of the installation of injection wells to promote the anaerobic biodegradation of organic COCs within part of the ground water plume. The deed and land use restrictions would be identical to those of the previous alternative with the addition of treatment of the VOCs in some areas of the shallow and deep ground water aquifers. *In situ* anaerobic biodegradation would be conducted through the injection of an aqueous substrate into selected regions of the shallow and deep aquifer. This would provide nutrients and a carbon source to be consumed by

the natural microbial population in the subsurface. The “microbials” would consume this food source along with dissolved oxygen in the ground water. As the dissolved oxygen concentrations in the ground water decrease over time, the bacteria may begin to use the chlorinated organic compounds as oxygen substitutes, thereby accelerating the breaking down of the dissolved phase organic COC molecules.

Installing injection wells in bedrock ground water may not be feasible due to the technical difficulty in effectively locating bedrock fractures as well as attempting to overcome mass transfer limitations of the injected solution through regions of the bedrock.

The plume outside the treatment zone would be addressed through the deed and land use restrictions, and long-term monitoring program. The estimated capital cost of this alternative exceeds an initial \$1,000,000 outlay, with annual operation and maintenance costs of \$468,000. The total project costs for this alternative are estimated at \$3,619,000.

The expected outcome from the implementation of this alternative is *no beneficial use of ground water, as treatment of portions of the down gradient plume would not address the source area allowing migration of the COCs to continue. Land and deed use restrictions would remain in force and effect.*

4. The **Vacuum-Vaporizer Wells and Deed Restrictions/Long-Term Monitoring** alternative is a variation on the last strategy, utilizing the installation of Vacuum-Vaporizer Wells to treat shallow and deep ground water source areas in addition to long-term monitoring of ground water to confirm no unacceptable risk. There would be 5-year reviews because of the concentration of COCs remaining on site, and above health based levels. This alternative provides for treatment of VOCs in some areas of the shallow and deep ground water aquifers. The vacuum-Vaporizer Wells would partition VOCs in ground water into the air within the well. The “offgas” air would then be treated with granular activated carbon (GAC) prior to discharge into the atmosphere. Periodic sampling of the discharge system would be included in the long-term monitoring program.

This system would not likely treat bedrock ground water or down gradient areas of the ground water plume. Risks associated with elevated concentrations of the COCs in these areas would be addressed, again, through the deed and land use restrictions placed on the property. The estimated capital cost of this alternative exceeds an initial \$1,380,000 outlay, with annual operation and maintenance costs of \$468,000. The total project costs for this alternative are estimated at \$5, 867,000.

The expected outcome from the implementation of this alternative is *no beneficial use of ground water, as treatment of portions of the down gradient*

plume would not address the source area, allowing migration of the COCs to continue. Land and deed use restrictions would remain in force and effect.

5. The Permeable Reaction Wall and Deed Restrictions/Long Term

Monitoring alternative includes a remedial program of installed vertical sheet piles to channel impacted shallow and deep ground water through an *in situ* permeable, reactive wall that will promote the degradation of chlorinated COCs. Additional ground water monitoring wells would be installed on the down gradient side of the reactive wall, and “piezometers” would be installed outside the steel sheet piles as part of the performance monitoring. There would be 5-year reviews because the COCs would remain onsite at concentrations above health levels.

This system provides for the treatment of most of the VOCs in shallow and deep ground water that would be exiting the site. The sheet pile wall would extend down to the bedrock surface on the eastern and western sides of the underground plume to channel it through the permeable reactive wall located at the southern shoreline of the Point. An iron-based catalyst within the reactive wall would promote the degradation of most halogenated compounds by “abiotic” or biological processes. The treatment sections of the reactive wall would be maintained and replaced as required, in order to replenish the iron-based catalyst.

This emerging technology alternative will not treat some of the VOCs in the bedrock ground water, or in the shallow and deep ground water source areas. The human health risks however, would be addressed through the deed and land use restrictions, and the long-term monitoring program. The estimated initial capital outlay for this alternative is \$6,285,000, with annual operation and maintenance costs of \$357,000. The total project costs for this alternative are estimated at \$9,062,000.

The expected outcome from the implementation of this alternative is no beneficial use of ground water, as treatment of portions of the down gradient plume would not address the source area, allowing migration of the COCs to continue. The potential risk due to discharge of COCs into Allen Harbor however, would be lessened. Land and deed use restrictions would remain in force and effect.

It is clear from the outline of the remediation alternatives, through the NCP criteria applied by the United States Navy in selecting a remedy that met the national Super fund program goals of protecting human health and the environment; that of Deed Restrictions, and Long Term Monitoring, that the natural ground water resource has been compromised for the foreseeable, if not indefinite, future. This makes it unacceptable for human consumption and use, and therefore, the development of residential or commercial properties on Calf Pasture Point, remains untenable.

V. PREASSESSMENT SCREEN DETERMINATION OF NATURAL RESOURCE DAMAGES

The proposed method used to quantify the damage to the aquifer beneath Calf Pasture Point involves the use of the “recharge rate” of water in the aquifer. This is the rate at which water could have been used without depletion of the groundwater in the aquifer.

The ground water is brackish (0.5 to 10 parts per thousand) beneath the central and southern portions of the site, and central portion of the Allen Harbor. This would be potable with treatment by residential users, to “desalinate” the brackish conditions, but for the presence of the COCs. In the northern portion of the site, the ground water is fresh (less than 0.5 parts per thousand), but that part of the aquifer lies beneath the DANC disposal area. The salinity data suggest that the fresh and brackish water, (of a lower density), from the northern portion of the site flows up and over the denser wedge of saline ground water in the southern portion, on its way to discharge into the surface waters, within a zone a few hundred feet from the shoreline. Due to the chlorinated compounds discharged into the environment, the ground water is no longer safe for human consumption, use, or inhalation, during dermal contact through showering. The Record of Decision, liberally referenced in this analysis, places a ground water use restriction over the entire site. In addition, any construction on site, over the plume, would require a ventilation system for the human health protection from escaping gasses to indoor air.

In accordance with the Base Reuse plan, approved in 1994, the site is to be restricted to recreational use only. The aquifer beneath the 189acre site would have been classified as GA, or suitable for drinking water without treatment, but for the pollutant concentrations presently found in the entire aquifer. It is therefore classified as GA-NA, for “non-attainment” of drinking water quality standards. The aquifer does not meet the goals of a GB site. Because of the level of certain chlorinated compounds, ventilation is required in enclosed building areas, thereby further restricting residential development. The proposed method is therefore calculated as indicated.

Assumptions:

The total volume of water that has been adversely affected by the groundwater contamination at the Site was based upon the fact that the groundwater beneath the Site is unavailable for human consumption, use, inhalation, or contact through showering. The Record of Decision places a groundwater use restriction over the entire Site (189 Acres).

The value of the lost potable water was calculated using the water rates from the Town of North Kingstown, and its water department that are currently charged.

The value of the lost potable water was calculated over a period of time from the present out to the year 2032.

An effective annual interest rate of seven percent (7%) was used in the calculations to facilitate the engineering economic computations. The percentage is based upon conservative effective interest rates commonly used both in practice and by the State in past claims.

North Kingstown water rates are listed for the years given with an average of five and three tenths percent (5.3%) per year.

The calculations are as follows:

1997	=	\$1.528/1000	gallons
1998	=	\$1.592/	" "
1999	=	\$1.714/	" "
2000	=	\$1.863/	" "
2001	=	\$1.898/	" "
2002	=	\$1.953/	" "

Calculations:

The Town of North Kingstown’s water rates are;

- 1. Current municipal charge of \$1.93 per 1000 gallons;
- 2. Area of concern = 189 Acres;
 - $(43,560 \text{ ft}^2/\text{acre}) (189 \text{ acres}) = 8,232,840 \text{ ft}^2$
In order to determine the volume of contaminated water within this area a groundwater recharge rate of 25.0 inches per year was applied to the Site. This was the annual average recharge rate estimated for the neighboring Hunt Aquifer System that has the same stratified drift deposits above the water table as the Calf Pasture Point. Therefore;
 $(8,232,840^2) * (25 \text{ inches/year}) * (\text{ft}/12 \text{ inches}) = 17,151,750^3/\text{year};$
 $(17,151,750^3) * (7.48 \text{ gallons}/\text{ft}^3) = 128,304,009 \text{ gallons}$ of potential drinking water per year.

Engineering Economic Calculations:

The calculation on economic value projected out for thirty (30) years was taken from the Principles of Engineering Economic Analysis, J. White *et al.*, John Wiley & Sons, Inc. 1977.

The abbreviations used in the value calculations are as follows:

P = present worth,
F = future worth,
G = uniform gradient,
A = annual worth.

(A) The current value of annual water rate of yearly use equals the total of 128,304,009 gallons per year multiplied by \$1.953/1000 gallons, or **\$250,578**.

(B) The annual value of water increased costs due to inflation in the year 2032, at the rate of increase of 5.3% per year equals **\$1,120,359**.

(C) The average yearly increase in water rate over thirty years equals **\$29,992**.

(D) The present value of thirty (30) year supply of water is calculated according to the following formula;

$$P_{2002} = A (P/A \ 7\%, \ 30) + G(P/G, \ 7\% \ 30),$$

$$P_{2002} = \$250,578 (12.4090) + \$29,992 (120.9718),$$

$$P_{2002} = \$3,109,422 + \$3,628,186 = \$6,737,608.$$

Total Present Worth of Groundwater-Related Natural Resource Damages:

$$\mathbf{P_{2002} = \$6,737,608}$$

(E) The average footprint of a standard colonial or cape style two story house, based upon Rhode Island home appraisal professionals is 26' X 44' with an attached 24' X 24' garage;

$$(26' \times 44') + (24' \times 24') = 1,720 \text{ sq. ft.}$$

(F) The cost of membrane and piping to prevent gas from entering a house and garage based upon \$1.60 to \$1.80 per square foot average, estimated at a base of \$1.70 per square foot. The underground pipe to direct the gasses away from the

home, ranges from \$500.00 to \$700.00 per completed unit. The estimated base of \$600.00 per completed unit per household is used;

$$1,720 \text{ sq. ft.} \times \$1.70 + \$600.00 \text{ equals } \$3,524.00.$$

(G) Of the 189 acres associated with the Point, only 78.5 acres are affected by the building restriction. The total number of homes that would be affected by the 2 acre restriction, less the 15% ascribed to infrastructure, is 33 house lots;

$$33 \times \$3,524.00 \text{ (per home gas membrane unit) equals } \$116,292.$$

Total Present Worth of Air Related Natural Resource Damages:

$$\mathbf{P2002 = \$116,292}$$

(H) The total present day value of the Natural Resource Damage Assessment for Calf Pasture Point is calculated therefore as;

$$\begin{aligned} &\$6,737,608. \text{ (thirty year water supply) } + \\ &\$116,292. \text{ (gas protection for residences) } = \end{aligned}$$

Total Present Worth of Groundwater and Air-Related Natural Resource Damages:

$$\mathbf{P2002 = \$6,853,900.}$$

Based upon the information and projections contained in this Pre-assessment Screen, we have determined that it is appropriate to conduct a natural resource damage assessment for the NCBC Site 07, Calf Pasture Point, North Kingstown, Rhode Island.

Jan H. Reitsma, Director,
Rhode Island Department of Environmental Management
The State of Rhode Island and Providence Plantations
235 Promenade Street, Providence, Rhode Island 02908

Date: _____

Concurrence:

Director, Office of Environmental Policy and
Compliance, Department of the Interior of
The United States

Date: _____